

**DEPARTMENT OF CONSUMER AND INDUSTRY SERVICES
DIRECTOR'S OFFICE
OCCUPATIONAL HEALTH STANDARDS — INORGANIC ARSENIC (As)**

Filed with the Secretary of State on June 16, 1993 (as amended January 4, 2000)

These rules take effect 15 days after filing with the Secretary of State

(By authority conferred on the director of the department of consumer and industry services by section 24 of 1974 PA 154, MCL 408.1024, and Executive Reorganization Order Nos. 1996-1 and 1996-2, MCL 330.3101 and 445.2001)

R 325.51602, R 325.51610, R 325.51611, R 325.51614, R 325.51618, R 325.51619, and R 325.51628 of the Michigan Administrative Code are amended and R 325.51612 and R 325.51613 of the Code are rescinded as follows:

PART 308. INORGANIC ARSENIC (As)

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R 325.51601 Applicability.

arsenic of 5 micrograms per cubic meter of air (5 µg/m³) averaged over any 8-hour period.

(c) "Authorized person" means a person who is specifically required by the employer to enter a regulated area or a person who enters such an area as a designated representative of employees for the purpose of observing the monitoring and measuring procedures under R 325.51627.

(d) "Department" means the department of consumer and industry services.

(e) "Director" means the director of the department or the designee of the director.

Rule 601. These rules apply to all occupational exposures to inorganic arsenic, except that they do not apply to employee exposures in agriculture or to exposures that result from pesticide application, the treatment of wood with preservatives, or the use of arsenically preserved wood.

R 325.51602 Definitions.

Rule 602. As used in these rules:

(a) "Act" means Act No. 154 of the Public Acts of 1974, as amended, being §408.1001 et seq. of the Michigan Compiled Laws.

(b) "Action level" means a concentration of inorganic

(f) "Inorganic arsenic" means elemental arsenic, copper acetoarsenite, and all inorganic compounds containing arsenic, except arsine, measured as arsenic (As).

(g) "O.H. rule" means an occupational health rule which is adopted by reference pursuant to section 14 of the act or promulgated pursuant to section 24 of the act. Copies of these rules are available from the Michigan department of consumer and industry services, standards division.

R 325.51603 Employee exposure limits; skin or eye contact.

Rule 603. (1) An employer shall assure that an employee is not exposed to inorganic arsenic at concentrations of more than 10 ug/m³, averaged over any 8-hour period.

(2) An employer shall assure that an employee is not exposed to skin or eye contact with arsenic trichloride or to skin or eye contact with liquid or particulate inorganic arsenic which is likely to cause skin or eye irritation.

R 325.51604 Regulated areas; report of information to director; change of information.

Rule 604. (1) Within 60 days after the effective date of these rules or within 60 days after the introduction of inorganic arsenic into the workplace, an employer who is required to establish a regulated area in his or her workplace shall report all of the following information in writing to the director:

- (a) The address of the workplace.
- (b) The approximate number of employees who will be working in a regulated area.
- (c) A brief summary of the operations creating the exposure and the actions which the employer intends to take to reduce exposure if it exceeds the permissible exposure limit.

(2) If there is a significant change in the information required by this rule, an employer shall report the changes in writing to the director within 60 days of the change.

R 325.51605 Employee exposure; determination of airborne exposure levels; collection of samples; monitoring and measurement accuracy; written notice to employee of exposure level.

Rule 605. (1) For the purpose of these rules, an employee exposure is that exposure which would occur if an employee were not using a respirator.

(2) A determination of airborne exposure levels shall be made from air samples that are representative of an employee's exposure to inorganic arsenic over an 8-hour period.

(3) The employer shall collect full shift personal samples for not less than 7 continuous hours which shall include at least 1 sample for each shift for each job classification and work area.

(4) An employer shall use a method of monitoring and measurement which has an accuracy of not less than plus or minus 25% for concentrations of inorganic arsenic of more than or equal to 10 micrograms per cubic meter (10 ug/m³) with a confidence level of 95%.

(5) An employer shall use a method of monitoring and measurement which has an accuracy of not less than plus or minus 35% for concentrations of inorganic arsenic of more than 5 micrograms per cubic meter (5 ug/m³) but less than 10 micrograms per cubic meter (10 ug/m³) with a confidence level of 95%.

(6) Within 5 working days after the receipt of monitoring results, an employer shall provide an employee with written notice of the results which represent that employee's exposure.

(7) If the results indicate that the representative employee exposure exceeds the permissible exposure limit, the employer shall include in the written notice a statement that the permissible exposure limit was exceeded and a description of the corrective action taken to reduce exposure to or below the permissible exposure limit.

R 325.51606 Employee exposure; monitoring exposure below action level, above permissible limit, and above action level but below permissible limit; duration of monitoring; additional monitoring.

Rule 606. (1) An employer who has a workplace or work operation that is subject to these rules shall monitor each workplace or work operation to accurately determine the airborne concentration of inorganic arsenic to which an employee may be exposed.

(2) If the initial monitoring reveals an employee exposure to be below the action level, the measurements need not be repeated, except as otherwise provided in subrule (6) of this rule.

(3) If the initial monitoring or subsequent monitoring reveals employee exposure to be above the permissible exposure limit, an employer shall repeat monitoring at least once every 3 months.

(4) If the initial monitoring or subsequent monitoring reveals employee exposure to be above the action level and below the permissible exposure limit, an employer shall repeat monitoring at least once every 6 months.

(5) An employer shall continue monitoring at the required frequency until not less than 2 consecutive measurements, taken not less than 7 days apart, are below the action level. When the measurements are obtained, the employer may discontinue monitoring for that employee until such time as any of the events in subrule (6) of this rule occur.

(6) If a production process, control, or personnel change is made that might result in new or additional exposure to inorganic arsenic, or if an employer has any other reason to suspect a change that might result in new or additional employee exposure to inorganic arsenic, additional monitoring that is in compliance with the provisions of R 325.51605 and this rule shall be conducted.

R 325.51607 Regulated areas; establishment; demarcation and segregation; access; respiratory protection; prohibited activities.

Rule 607. (1) An employer shall establish a regulated area where worker exposure to inorganic arsenic is in excess of the permissible limit, without regard to the use of a respirator.

(2) A regulated area shall be demarcated and segregated from the rest of the workplace in a manner that minimizes the number of persons who will be exposed to inorganic arsenic.

(3) Access to a regulated area shall be limited to authorized persons or to persons who are otherwise authorized to enter such areas by the act or the rules promulgated pursuant thereto.

(4) A person entering a regulated area shall be supplied with a respirator which is selected pursuant to rule 611.

(5) In a regulated area, an employer shall assure that neither food nor beverages are consumed, that smoking products, chewing tobacco, and gum are not used, and that cosmetics are not applied, except that these activities may be conducted in lunchrooms, change rooms, and showers required by rule 616. Drinking water may be consumed in the regulated area.

R 325.51608 Engineering and work practice controls to reduce employee exposure.

Rule 608. (1) Where monitoring establishes that employees are exposed to airborne concentrations of inorganic arsenic which are above the established permissible exposure limit, an employer shall institute, at the earliest possible time, engineering and work practice controls to reduce exposures to or below the permissible exposure limit, except to the extent that the employer can establish that such controls are not feasible.

(2) If engineering and work practice controls are not sufficient to reduce exposures to or below the permissible exposure limit, they shall nonetheless be used to reduce exposures to the lowest levels achievable by these controls and shall be supplemented by the use of respirators, pursuant to rules 610 to 613, and other necessary personal protective equipment. Employee rotation is not required as a control strategy before respiratory protection is instituted.

R 325.51609 Employee exposure; written programs to reduce exposure by means of engineering and work practice controls; content; availability; revision and update.

Rule 609. (1) An employer shall establish and implement a written program to reduce exposures to or below the permissible exposure limit by means of engineering and work practice controls.

(2) A written program shall include, at a minimum, all of the following:

- (a) A description of each operation in which inorganic arsenic is emitted; for example, machinery used, material processed, controls in place, crew size, operating procedures, and maintenance practices.
- (b) Engineering plans and studies used to determine the methods selected for controlling exposure to inorganic arsenic.
- (c) A report of the technology considered in meeting the permissible exposure limit.
- (d) Monitoring data.
- (e) A detailed schedule for the implementation of the engineering controls and work practices which cannot be implemented immediately and for the adaption and implementation of any additional engineering and work practices which are necessary to meet the permissible exposure limit.
- (f) If an employer currently does not achieve the permissible exposure limit with engineering controls and work practices, the employer shall include an analysis of the effectiveness of the various controls in the written program and implement a plan to minimize the discomfort and maximize the effectiveness of respirator use.
- (g) Other relevant information.

(3) The written program shall be submitted, upon request, to the director and shall be available to the director, affected employees, or authorized employee representatives at the worksite for examination and copying.

(4) The program required by this rule shall be revised and updated at least once every 6 months to reflect the current status of the program.

R 325.51610 Respirators; use.

Rule 610. For employees who use respirators required by these rules, the employer shall provide respirators that comply with the requirements of this rule. Respirators shall be used during all of the following:

- (a) Periods necessary to install or implement feasible engineering or work practice controls.
- (b) Work operations, such as maintenance and repair activities, for which the employer establishes that engineering

and work practice controls are not feasible

(c) Work operations for which engineering and work practice controls are not yet sufficient to reduce employee exposures to or below the permissible exposure limit.

(d) Emergencies.

R 325.51611 Respirator program.

Rule 611. (1) The employer shall implement a respiratory protection program in accordance with 29 C.F.R. 1910.134(b) to (d) and (f) to (m), except for (d)(iii), as adopted by reference in Michigan Administrative Rule R 325.60051 et seq.

(2) If an employee exhibits breathing difficulty during fit testing or respirator use, then the employee shall be examined by a physician trained in pulmonary medicine to determine whether the employee can use a respirator while performing the required duty.

(3) Table 1 reads as follows:

**TABLE 1
RESPIRATORY PROTECTION FOR INORGANIC ARSENIC PARTICULATE,
EXCEPT FOR THOSE WITH SIGNIFICANT VAPOR PRESSURE**

Concentration of inorganic arsenic (as As) or condition of use	Required respirator
(a) Unknown or greater or lesser than 20,000 $\mu\text{g}/\text{m}^3$ (20 mg/m^3) or firefighting	Any full-facepiece, self-contained breathing apparatus operated in positive pressure mode.
(b) Not greater than 20,000 $\mu\text{g}/\text{m}^3$ (20 mg/m^3)	Supplied-air respirator with full facepiece, hood, helmet, or suit and operated in positive pressure mode.
(c) Not greater than 10,000 $\mu\text{g}/\text{m}^3$ (10 mg/m^3)	(i) Powered air-purifying respirators in all inlet face coverings with high-efficiency filters. ¹ (ii) Half-mask, supplied-air respirator operated in positive pressure mode.
(d) Not greater than 500 $\mu\text{g}/\text{m}^3$	(i) Full-facepiece, air purifying respirator equipped with high-efficiency filter. ¹ (ii) Any full-facepiece, supplied-air respirator. (iii) Any full-facepiece, self-contained breathing apparatus.
(e) Not greater than 100 $\mu\text{g}/\text{m}^3$	(i) Half-mask, air-purifying respirator equipped with high-efficiency filter. ¹ (ii) Any half-mask, supplied-air respirator.

¹High-efficiency filter--99.7 pct efficiency against 0.3 micrometer monodisperse diethyl-hexyl phthalate (DOP) particles.

(4) Table 2 reads as follows:

**TABLE 2
RESPIRATORY PROTECTION FOR INORGANIC ARSENICALS (SUCH AS ARSENIC TRICHLORIDE² AND ARSENIC PHOSPHIDE) WITH SIGNIFICANT VAPOR PRESSURE**

Concentration of inorganic arsenic (as As) or condition of use	Required respirator
(a) Unknown or greater or lesser than 20,000 $\mu\text{g}/\text{m}^3$ (20 mg/m^3) or firefighting	Any full-facepiece, self-contained breathing apparatus operated in positive pressure mode.
(b) Not greater than 20,000 $\mu\text{g}/\text{m}^3$ (20 mg/m^3)	Supplied-air respirator with full facepiece, hood, helmet, or suit and operated in positive pressure mode.
(c) Not greater than 10,000 $\mu\text{g}/\text{m}^3$ (10 mg/m^3)	Half-mask ² , supplied-air respirator operated in positive pressure mode.
(d) Not greater than 500 $\mu\text{g}/\text{m}^3$	(i) Front or back-mounted gas mask equipped with high-efficiency filter ¹ and acid gas canister. (ii) Any full-facepiece supplied air respirator. (iii) Any full-facepiece self-contained breathing apparatus.
(e) Not greater than 100 $\mu\text{g}/\text{m}^3$	(i) Half-mask ² air-purifying respirator equipped with high-efficiency filter ¹ and acid gas cartridge. (ii) Any half-mask, supplied air respirator.

¹High efficiency filter--99.7 pct efficiency against 0.3 micrometer monodisperse diethyl-hexyl phthalate (DOP) particles.

²Half-mask respirators shall not be used for protection against arsenic trichloride, as it is rapidly absorbed through the skin.

(5) The employer shall use table 1 of this rule to select the appropriate respirator or combination of respirators for inorganic arsenic compounds without significant vapor pressure, and the employer shall use table 2 of this rule to select the appropriate respirators for inorganic arsenic compounds that have significant vapor pressure

(6) If employee exposures exceed the permissible exposure limit for inorganic arsenic and also exceed the relevant limit for other gases, such as sulfur dioxide, then an air-purifying respirator provided to the employee as specified by this rule shall have a combination high-efficiency filter with an appropriate gas sorbent. (See footnote in table 1 of this section).

(7) Employees required to use respirators may choose, and the employer shall provide, a powered air-purifying

respirator if the powered air-purifying respirator will provide proper protection. In addition, the employer shall provide a combination dust and acid-gas respirator to employees who are exposed to gases over the relevant exposure limits.

R 325.51612 Rescinded.

R 325.51613 Rescinded.

R 325.51614 Protective work clothing and equipment; provision and use; cleaning and replacement; notice to cleaning or laundering persons of the potentially harmful effects of exposure to inorganic arsenic.

Rule 614. (1) If the possibility of skin or eye irritation from inorganic arsenic exists, and for all employees working

in a regulated area, an employer shall provide, at no cost to the employee, and shall assure that employees use, appropriate and clean protective work clothing and equipment, such as the following:

- (a) Coveralls or similar full-body work clothing.
- (b) Gloves and shoes or coverlets.

(c) Face shields or vented goggles if necessary to prevent eye irritation. Such shields or goggles shall comply with R 408.13311 to R 408.13313 and R 408.13340 to R 408.13369 of the Michigan Administrative Code, which are administered and enforced by the Michigan department of consumer and industry services.

(d) Impervious clothing for employees who are subject to exposure to arsenic trichloride.

(2) An employer shall provide the protective clothing that is required in subrule (1) of this rule in a freshly laundered and dry condition at least once each week. If an employee works in an area where the exposure to inorganic arsenic is over 100 micrograms per cubic meter (100 ug/m³) or in an area where more frequent washing is needed to prevent skin irritation, then the protective clothing shall be laundered daily.

(3) An employer shall clean, launder, or dispose of protective clothing that is required by subrule (1) of this rule.

(4) An employer shall repair or replace the protective clothing and equipment as necessary to maintain the effectiveness of the protective clothing and equipment.

(5) At the completion of a work shift, an employer shall assure that all protective clothing is removed only in change rooms prescribed in R 325.51616(1).

(6) An employer shall assure that contaminated protective clothing which is to be cleaned, laundered, or disposed of is placed in a closed container in the change room in a manner that prevents the dispersion of inorganic arsenic outside the container.

(7) An employer shall inform, in writing, any person who cleans or launders clothing that is required by this rule of the potentially harmful effect, including the carcinogenic effects, of exposure to inorganic arsenic.

(8) An employer shall assure that the containers of contaminated protective clothing and equipment which are in the workplace or which are to be removed from the workplace are labeled as follows:

CAUTION: Clothing contaminated with inorganic arsenic; do not remove dust by blowing or shaking. Dispose of inorganic arsenic-contaminated wash water pursuant to applicable local, state, or federal regulations.

(9) An employer shall prohibit the removal of inorganic arsenic from protective clothing or equipment by blowing or shaking.

R 325.51615 Hygiene procedures; written housekeeping and maintenance plan; equipment maintenance.

Rule 615. (1) All surfaces under the employer's control shall be maintained as free of accumulations of inorganic arsenic as practicable.

(2) Floors and other accessible surfaces that are contaminated with inorganic arsenic shall not be cleaned by the use of compressed air. Shoveling and brushing may be used only if vacuuming or other relevant methods have been tried and found to be ineffective.

(3) If vacuuming methods are selected, the vacuums shall be used and emptied in a manner to minimize the reentry of inorganic arsenic into the workplace.

(4) A written housekeeping plan and maintenance plan shall be established and implemented. The plan shall list the appropriate frequencies for carrying out housekeeping operations and for cleaning and maintaining dust collection equipment. The plan shall be available for inspection by the director.

(5) Periodic cleaning of dust collection and ventilation equipment and checks of their effectiveness shall be carried out to maintain the effectiveness of the system and a notation shall be kept of the last check of effectiveness and cleaning or maintenance.

R 325.51616 Hygiene facilities and practices; change rooms; showers; lavatories; lunchrooms.

Rule 616. (1) For employees who work in a regulated area or who are subject to the possibility of skin or eye irritation from inorganic arsenic, an employer shall provide clean change rooms equipped with storage facilities for street clothes and separate storage facilities for protective clothing equipment pursuant to O.H. rule 4201(5)--Sanitation.

(2) An employer shall provide shower facilities pursuant to O.H. rule 4201(4)(c)--Sanitation, and shall assure that an employee who works in a regulated area or who is subject to the possibility of skin or eye irritation from inorganic arsenic showers at the end of the workshift.

(3) For employees who work in a regulated area, an employer shall provide lunchroom facilities which have temperature-controlled, positive pressure, filtered air samples and which are readily accessible to employees who work in a regulated area.

(4) An employer shall provide lavatory facilities which comply with O.H. rule 4201(4)(a) and (b)--Sanitation, and shall assure that an employee who works in the regulated area or who is subject to the possibility of skin or eye irritation from exposure to inorganic arsenic washes his or her hands and face before eating.

(5) For an employee who works in an area where exposure to inorganic arsenic, without regard to the use of respirators, exceeds 100 micrograms per cubic meter (100 ug/m³), an employer shall provide facilities to vacuum his or her protective clothing and to clean or change shoes worn in such areas before entering change rooms, lunchrooms, shower rooms and shall assure their use.

(6) If engineering controls and work practices currently reduce exposures below the permissible exposure limit for affected employees, then change room, shower, lavatory, and lunchroom facilities need not be completed until December 31, 1980.

R 325.51617 Medical surveillance program generally.

Rule 617. (1) An employer shall institute a medical surveillance program for the following employees:

(a) An employee who is or will be exposed to inorganic arsenic above the action level, without regard to the use of a respirator, for not less than 30 days per year.

(b) An employee who has been exposed above the action level, without regard to the use of a respirator, for 30 days or more per year for a total of 10 years or more of combined employment with the employer or predecessor employers before or after the effective date of these rules. The determination of exposures before the effective date of these rules shall be based upon prior exposure records, comparison with the first measurements taken after the effective date of these rules, or comparison with records of exposures in areas with similar processes, extent of engineering controls utilized, and materials used by the employer.

(2) An employer shall assure that medical examinations and procedures are all performed by or under the supervision of a licensed physician, without cost to an employee, without loss of pay, and at a reasonable time and place.

R 325.51618 Medical surveillance program; initial examinations.

Rule 618. (1) Within 60 days after the effective date of these rules, an employer shall provide an opportunity for an

initial medical examination, if not already provided, to an employee who is covered by the medical provisions of these rules.

(2) An employer shall provide an opportunity for an initial medical examination at the time of the first assignment to an area where the employee is likely to be exposed to more than the action level of inorganic arsenic for not less than 30 days per year.

(3) The initial medical examination shall include all of the following elements:

- (a) A work history and a medical history that shall include a smoking history and the presence and degree of respiratory symptoms, such as breathlessness, cough, sputum production, and wheezing.
- (b) A 14-inch by 17-inch posterior-anterior chest X ray and the international labor office UICC/Cincinnati (ILO U/C) rating.
- (c) A nasal and skin examination.
- (d) Other examinations that the physician believes are appropriate because of the employee's exposure to inorganic arsenic or because of required respirator use.

R 325.51619 Medical surveillance program; periodic examination.

Rule 619. (1) An employer shall provide the examinations specified in R 325.51618(3)(a) to (d) at least once a year for a covered employee who is under 45 years of age and who has less than 10 years of exposure to inorganic arsenic above the action level, without regard to respirator use.

(2) An employer shall provide a medical examination as specified in R 325.51618(3) (a),(c), and (d) at least semiannually and the X ray requirement specified in R 325.51618(3)(b) at least annually for other covered employees.

(3) If a covered employee has not taken the examination specified in R 325.51618(3) within 6 months before the termination of employment, then the employer shall provide the examination to the employee upon termination of employment.

(4) If for any reason an employee develops signs or symptoms commonly associated with exposure to inorganic arsenic, then the employer shall provide an appropriate examination and emergency medical treatment.

R 325.51620 Medical surveillance program; information provided to physician by employer.

Rule 620. An employer shall provide all of the following information to the examining physician:

- (a) A copy of these rules with appendices.
- (b) A description of the affected employee's duties as they relate to the employee's exposure.
- (c) The employee's representative exposure level or anticipated exposure level.
- (d) A description of any personal protective equipment used or to be used.
- (e) Information from previous medical examinations of the affected employee which is not readily available to the examining physician.

R 325.51621 Medical surveillance program; physician's written opinion; content: providing copy to employee.

Rule 621. (1) An employer shall obtain a written opinion from the examining physician which shall include all of the following:

- (a) The results of the medical examination and tests performed.
- (b) The physician's opinion as to whether the employee has any detected medical conditions which would subject the employee to an increased risk of material health impairment from exposure to inorganic arsenic.

- (c) Any recommended limitations upon the employee's exposure to inorganic arsenic or upon the use of protective clothing or equipment such as respirators.
- (d) A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further explanation or treatment.

(2) An employer shall instruct the physician not to reveal in the written opinion specific findings or diagnoses unrelated to occupational exposure.

(3) An employer shall provide a copy of the written opinion to the affected employee.

R 325.51622 Employee information and training program; applicability; provision of information to employees; availability of rules and other materials to employees and director.

Rule 622. (1) An employer shall institute a training program for all employees who are subject to exposure to inorganic arsenic above the action level, without regard to respirator use, or for whom there is the possibility of skin or eye irritation from inorganic arsenic. An employer shall assure that these employees participate in the training program.

(2) The training program shall be provided at the time of initial assignment for employees specified in subrule (1) of this rule and at least annually thereafter.

(3) An employer shall assure that each employee is informed of all of the following:

- (a) The information contained in appendix A to these rules.
- (b) The quantity, location, and manner of use or storage of arsenic materials, sources of exposure, and the specific nature of operations that could result in exposure to inorganic arsenic, as well as any necessary protective steps.
- (c) The purpose, proper use, and limitation of respirators.
- (d) The purpose and a description of the medical surveillance program as required by R 325.51617 to R 325.51621.
- (e) The engineering controls and work practices that are associated with the employee's job assignment.
- (f) These rules, which the employer shall review.

(4) An employer shall make a copy of these rules and their appendices readily available to all affected employees.

(5) Upon request, an employer shall provide, to the director, all materials that relate to the employee information and training program.

R 325.51623 Warning signs and labels; employer responsibilities.

Rule 623. (1) An employer shall post signs which bear the following legend to demarcate regulated areas:

**DANGER
INORGANIC ARSENIC
CANCER HAZARD
AUTHORIZED PERSONNEL ONLY
NO SMOKING OR EATING
RESPIRATOR REQUIRED**

(2) An employer shall assure that signs required by this rule are illuminated and cleaned as necessary so that the legend is readily visible.

(3) An employer shall apply precautionary labels to all shipping and storage containers of inorganic arsenic and to all products containing inorganic arsenic except when the inorganic arsenic in the product is bound in such a manner so as to make the possibility of airborne exposure to inorganic arsenic unlikely. Possible examples of products that do not require labels are semiconductors, light emitting diodes, and glass. The labels shall bear the following legend:

**DANGER
CONTAINS INORGANIC ARSENIC
CANCER HAZARD
HARMFUL IF INHALED OR SWALLOWED
USE ONLY WITH ADEQUATE VENTILATION OR
RESPIRATORY PROTECTION**

(4) An employer shall assure that statements do not appear on or near any sign or label required by this rule which contradict or detract from the meaning of the required sign or label.

(5) An employer may use labels or signs required by other statutes, rules, or ordinances in addition to, or in combination with, signs and labels required by this rule.

R 325.51624 Monitoring and medical surveillance records; maintenance.

Rule 624. (1) An employer shall establish and maintain an accurate record of all monitoring required by rules 605 and 606 of these rules, including all of the following:

- (a) The date, duration, location, and results of each sample taken, including, where applicable, a description of the sampling procedure used to determine representative employee exposure.
- (b) A description of the sampling and analytical methods used and evidence of their accuracy.
- (c) The type of respiratory protective devices worn, if any.
- (d) Names, social security numbers, and job classifications of the employees monitored and of all other employees whose exposure the measurement is intended to represent.
- (e) The environmental variables that could affect the measurement of the employee's exposure.

(2) An employer shall maintain the monitoring records for not less than 40 years or for the duration of employment plus 20 years, whichever period is longer.

(3) An employer shall establish and maintain an accurate record for each employee who is subject to medical surveillance as required by rules 617 to 621 of these rules, including all of the following:

- (a) The name, social security number, and description of duties of the employee.
- (b) A copy of the physician's written opinion.
- (c) Results of any exposure monitoring done for that employee and the representative exposure levels supplied to the physician.
- (d) Any employee medical complaints related to exposure to inorganic arsenic.

(4) An employer shall keep, or assure that the examining physician keeps, the following medical records:

- (a) A copy of the medical examination results, including medical and work histories required by rules 617 to 621 of these rules.
- (b) A description of the laboratory procedures and a copy of any standards or guidelines used to interpret the test results or references to that information.
- (c) The initial x ray.
- (d) The x rays for the most recent 5 years.
- (e) Any x-ray film with a demonstrated abnormality and all subsequent x-ray films.
- (f) The initial cytologic examination slide and written description.
- (g) The cytologic examination slides and written descriptions for the most recent 5 years.
- (h) Any cytologic examination slides with demonstrated atypia, if such atypia persists for 3 years, and all subsequent slides and written descriptions.

(5) An employer shall maintain, or assure that the physician maintains, the medical records for not less than 40 years or for the duration of employment plus 20 years, whichever period is longer.

R 325.51625 Availability of records.

Rule 625. (1) Upon request, an employer shall make all records that are required to be maintained pursuant to the provisions of R 325.51624 available to the director for examination and copying.

(2) Upon request, an employer shall make all records that are required pursuant to the provisions of R 325.51624 available to affected employees, former employees, and their designated representatives in accordance with the provisions of R 325.3451 et seq.

R 325.51626 Retention and disposal of records; successor employer; transmittal and notice to director.

Rule 626. (1) If an employer ceases to do business, the successor employer shall receive and retain all records that are required to be maintained by these rules.

(2) If an employer ceases to do business and there is no successor employer to receive and retain the records that are required to be maintained by these rules for the prescribed period, the records shall be transmitted to the director.

(3) At the expiration of the retention period for the records that are required to be maintained by these rules, an employer shall notify the director not less than 3 months before the disposal of the records and shall transmit those records to the director if requested within that period.

R 325.51627 Exposure monitoring; employee observation.

Rule 627. (1) An employer shall provide an affected employee or a designated employee representative with an opportunity to observe any monitoring of employee exposure to inorganic arsenic which is conducted pursuant to these rules.

(2) If observation of the monitoring of employee exposure to inorganic arsenic requires entry into an area where the use of respirators, protective clothing, or equipment is required, an employer shall provide the observer with, and assure the use of, such respirators, clothing, and equipment, and shall require the observer to comply with all other applicable safety and health procedures.

(3) If the monitoring is not interfered with, observers shall be entitled to all of the following:

- (a) To receive an explanation of the measurement procedures.
- (b) To observe all steps related to the monitoring of inorganic arsenic performed at the place of exposure.
- (c) To record the results obtained or to receive copies of the results when returned to the laboratory.

R 325.51628 Availability of rules and appendices; permission to reproduce.

Rule 628. (1) A copy of these rules and related appendices, which are titled "Appendix A--Substances Information Sheet," "Appendix B--Substance Technical Information," and "Appendix C--Medical Surveillance Information," are available to affected employers and employees at no cost from the Michigan Department of Consumer and Industry Services, Standards Division, P.O. Box 30643, Lansing, Michigan 48909.

(2) Permission to reproduce any of these documents in full is granted by the director.

(3) The information contained in the appendices to this section is not intended by itself to create any additional obligations not otherwise imposed by this standard nor detract from any existing obligation.

APPENDICES TO MIOSHA STANDARD FOR INORGANIC ARSENIC (As) (R 325.51601 - R 325.51628)

APPENDIX A — SUBSTANCE INFORMATION SHEET

I. SUBSTANCE IDENTIFICATION

A. Substance: Inorganic Arsenic (As)

B. Definition: Copper acetoarsenite, arsenic and all inorganic compounds containing arsenic, except arsine, measured as arsenic (As).

C. Permissible Exposure Limit: 10 micrograms per cubic meter of air as determined as an average over an 8-hour period. No employee may be exposed to any skin or eye contact with arsenic trichloride or to skin or eye contact likely to cause skin or eye irritation.

D. Regulated areas. Only employees authorized by the employer should enter a regulated area.

II. HEALTH HAZARD DATA

A. Comments: The health hazard of inorganic arsenic is high.

B. Ways in which the chemical affects your body: Exposure to airborne concentrations of inorganic arsenic may cause lung cancer, and may be a skin irritant. Inorganic arsenic may also affect your body if swallowed. One compound in particular, arsenic trichloride, is especially dangerous because it can be absorbed readily through the skin. Because inorganic arsenic is a poison, you should wash your hands thoroughly prior to eating or smoking.

III. PROTECTIVE CLOTHING AND EQUIPMENT

A. Respirators: Respirators will be provided by your employer at no cost to you for routine use if your employer is in the process of implementing engineering and work practice controls or where engineering and work practice controls are not feasible or insufficient. You must wear respirators for non-routine activities or in emergency situations where you are likely to be exposed to levels of inorganic arsenic in excess of the permissible exposure limit. Since how well your respirator fits your face is very important, your employer is required to conduct fit tests to make sure the respirator seals properly when you wear it. These tests are simple and rapid and will be explained to you during training sessions.

B. Protective Clothing: If you work in a regulated area, your employer is required to provide at no cost to you, and you must wear, appropriate, clean, protective clothing and equipment. The purpose of this equipment is to prevent you from bringing into your home arsenic contaminated dust and to protect your body from repeated skin contact with inorganic arsenic likely to cause skin irritation. This clothing should include such items as coveralls or similar full-body clothing, gloves, shoes or coverlets, and aprons. Protective equipment should include face shields or vented goggles, where eye irritation may occur.

IV. HYGIENE FACILITIES AND PRACTICES

You must not eat, drink, smoke, chew gum or tobacco, or apply cosmetics in the regulated area, except that drinking water is permitted. If you work in a regulated area your employer is required to provide lunchrooms and other areas for these purposes.

If you work in a regulated area, your employer is required to provide showers, washing facilities, and change rooms. You must wash your face, and hands before eating and must shower at the end of the workshift. Do not take used protective clothing out of change rooms without your employer's permission. Your employer is required to provide for laundering or cleaning of your protective clothing.

V. SIGNS AND LABELS

Your employer is required to post warning signs and labels for your protection. Signs must be posted in regulated areas. The signs must warn that a cancer hazard is present, that only authorized employees may enter the area, that no smoking or eating is allowed, and that respirators must be worn.

VI. MEDICAL EXAMINATIONS

If your exposure to arsenic is over the Action Level (5 ug/m³)-(Includes all persons working in regulated areas) at least 30 days per year, or you have been exposed to arsenic for more than 10 years over the Action Level, your employer is required to provide you with a medical examination. The examinations shall be every 6 months for employees over 45 years old or with more than 10 years exposure over the Action Level and annually for other covered employees. The medical examination must include a medical history; a chest x-ray; skin examination; and a nasal examination. The examining physician will provide a written opinion to your employer containing the results of the medical exams. You should also receive a copy of this opinion. The physician must not tell your employer any conditions he detects unrelated to occupational exposure to arsenic but must tell you those conditions.

VII. OBSERVATION OF MONITORING

Your employer is required to monitor your exposure to arsenic and you or your representatives are entitled to observe the monitoring procedure. You are entitled to receive an explanation of the measurement procedure, and to record the results obtained. When the monitoring procedure is taking place in an area where respirators or personal protective clothing and equipment are required to be worn, you must also be provided with and must wear the protective clothing and equipment.

VIII. ACCESS TO RECORDS

You or your representative are entitled to records of your exposure to inorganic arsenic and your medical examination records if you request your employer to provide them.

IX. TRAINING AND NOTIFICATION

Additional information on all of these items plus training as to hazards of exposure to inorganic arsenic and the engineering and work practice controls associated with your job will also be provided by your employer. If you are exposed over the permissible exposure limit, your employer must inform you of that fact and the actions he is taking to reduce your exposures.

APPENDIX B — SUBSTANCE TECHNICAL INFORMATION

ARSENIC, ARSENIC TRIOXIDE, ARSENIC TRICHLORIDE (THREE EXAMPLES)

I. Physical and chemical properties

- A. Arsenic (metal). CAS 7440-38-2
 1. Formula: As.
 2. Appearance: Gray metal
 3. Melting point: Sublimes without melting at 613°C.
 4. Specific Gravity: ($H_2O=1$) 5.73.
 5. Solubility in water: Insoluble.
- B. Arsenic Trioxide.
 1. Formula: As_2O_3 , (As_4O_6)
 2. Appearance: White powder.
 3. Melting point: 315°C.
 4. Specific Gravity: ($H_2O=1$) 3.74
 5. Solubility in water: 3.7 grams in 100cc of water at 20°C
- C. Arsenic Trichloride (liquid).
 1. Formula: $AsCl_3$
 2. Appearance: Colorless or pale yellow liquid.
 3. Melting point: -8.5°C
 4. Boiling point: 130.2°C
 5. Specific Gravity: ($H_2O=1$) 2.16 at 20°C
 6. Vapor Pressure: 10 mm Hg at 23.5°C
 7. Solubility in Water: Decomposes in water.

II. Fire, explosion and reactivity data.

- A. Fire: Arsenic, Arsenic Trioxide and Arsenic Trichloride are nonflammable.
- B. Reactivity:
 1. Conditions contributing to instability: Heat.
 2. Incompatibility: Hydrogen gas can react with inorganic arsenic to form the highly toxic gas arsine.

III. Monitoring and Measurement Procedures

Samples collected should be full shift (at least 7 hour) samples. Sampling should be done using a personal sampling pump at a flow rate of 1.5 liters per minute. Samples should be collected on 0.8 micrometer pore size membrane filter (37mm diameter). Volatile arsenicals such as arsenic trichloride can be most easily collected in a midge bubbler filled with 15 ml of 0.1 N NaOH.

The method of sampling and analysis should have an accuracy of not less than ± 25 percent (with a confidence limit of 95 percent) for 10 micrograms per cubic meter of air ($10 \mu g/m^3$) and ± 35 percent (with a confidence limit of 95 percent) for concentrations of inorganic arsenic between 5 and $10 \mu g/m^3$.

APPENDIX C — MEDICAL SURVEILLANCE INFORMATION

I. GENERAL

Medical examinations are to be provided for all employees exposed to levels of inorganic arsenic above the action level ($5 \mu g/m^3$) for at least 30 days per year (which would include among others, all employees who work in regulated areas). Examinations are also to be provided to all employees who have had 10 years or more exposure above the action level for more than 30 days per year while working for the present or predecessor employer though they may no longer be exposed above the action level.

An initial medical examination is to be provided to all such employees, if not already provided. In addition, an initial medical examination is to be provided to all employees who are first assigned to areas in which worker exposure will probably exceed $5 \mu g/m^3$ (after the effective date of this

standard) at the time of initial assignment. In addition to its immediate diagnostic usefulness, the initial examination will provide a baseline for comparing future test results. The initial examination must include as a minimum the following elements:

- (1) A work and medical history, including a smoking history, and presence and degree of respiratory symptoms such as breathlessness, cough, sputum production, and wheezing;
- (2) A 14" by 17" posterior-anterior chest x-ray and International Labor Office UICC/Cincinnati (ILO U/C) rating.
- (3) A nasal and skin examination; and

(4) Other examinations which the physician believes appropriate because of the employee's exposure to inorganic arsenic or because of required respirator use.

Periodic examinations are also to be provided to the employees listed above. The periodic examinations shall be given annually for those covered employees 45 years of age or less with fewer than 10 years employment in areas where employee exposure exceeds the action level (5 ug/m³). Periodic examinations need not include sputum cytology and only an updated medical history is required.

Periodic examinations for other covered employees shall be provided every six (6) months. These examinations shall include all tests required in the initial examination, except that the medical history need only be updated.

The examination contents are minimum requirements. Additional tests such as lateral and oblique x-rays or pulmonary function tests may be useful. For workers exposed to three arsenicals which are associated with lymphatic cancer (copper acetoarsenite, potassium arsenite, or sodium arsenite), the examination should also include palpation of superficial lymph nodes and complete blood count.

II. NONCARCINOGENIC EFFECTS

The OSHA standard is based on minimizing risk of exposed workers dying of lung cancer from exposure to inorganic arsenic. It will also minimize skin cancer from such exposures.

The following three sections quoted from "Occupational Diseases: A Guide to Their Recognition", Revised Edition, June 1977, National Institute for Occupational Safety and Health is include to provide information on the nonneoplastic effects of exposure to inorganic arsenic. Such effects should not occur if the OSHA standard are followed.

A. Local - Trivalent arsenic compounds are corrosive to the skin. Brief contact has no effect but prolonged contact results in a local hyperemia and later vesicular or pustular eruption. The moist mucous membranes are most sensitive to the irritant action. Conjunctiva, moist and macerated areas of skin, the eyelids, the angles of the ears, nose, mouth, and respiratory mucosa are also vulnerable to the irritant effects. The wrists are common sites of dermatitis, as are the genitalia if personal hygiene is poor. Perforations of the nasal septum may occur. Arsenic trioxide and pentoxide are capable of producing skin sensitization and contact dermatitis. Arsenic is also capable of producing keratoses, especially of the palms and soles.

B. Systemic - The acute toxic effects of arsenic are generally seen following ingestion of inorganic arsenical compounds. This rarely occurs in an industrial setting. Symptoms develop within to 4 hours following ingestion and are usually characterized by constriction of the throat followed by dysphagia, epigastric pain, vomiting, and watery diarrhea. Blood may appear in vomitus and stools. If the amount ingested is sufficiently high, shock may develop due to severe fluid loss, and death may ensue in 24 hours. If the acute effects are survived, exfoliative dermatitis and peripheral neuritis may develop.

Cases of acute arsenical poisoning due to inhalation are exceedingly rare in industry. When it does occur, respiratory tract symptoms cough, chest pain, dyspnea, giddiness, headache, and extreme general weakness precede

gastrointestinal symptoms. The acute toxic symptoms of trivalent arsenical poisoning are due to severe inflammation of the mucous membranes and greatly increased permeability of the blood capillaries.

Chronic arsenical poisoning due to ingestion is rare and generally confined to patients taking prescribed medications. However, it can be a concomitant of inhaled inorganic arsenic from swallowed sputum and improper eating habits. Symptoms are weight loss, nausea and diarrhea alternating with constipation, pigmentation and eruption of the skin, loss of hair, and peripheral neuritis. Chronic hepatitis and cirrhosis have been described. Polyneuritis may be the salient feature, but more frequently there are numbness and parasthenias of "glove and stocking" distribution. The skin lesions are usually melanotic and keratotic and may occasionally take the form of an intradermal cancer of the squamous cell type, but without infiltrative properties. Horizontal white lines (striations) on the fingernails and toenails are commonly seen in chronic arsenical poisoning and are considered to be a diagnostic accompaniment of arsenical polyneuritis.

Inhalation of inorganic arsenic compounds is the most common cause of chronic poisoning in the industrial situation. This condition is divided into three phases based on signs and symptoms.

First Phase: The worker complains of weakness, loss of appetite, some nausea, occasional vomiting, a sense of heaviness in the stomach, and some diarrhea.

Second Phase: The worker complains of conjunctivitis, a catarrhal state of the mucous membranes of the nose, larynx, and respiratory passage. Coryza, hoarseness, and mild tracheobronchitis may occur. Perforation of the nasal septum is common, and is probably the most typical lesion of the upper respiratory tract in occupational exposure to arsenical dust. Skin lesions, eczematoid and allergic in type, are common.

Third Phase: The worker complains of symptoms of peripheral neuritis, initially of hands and feet, which is essentially sensory. In more severe cases, motor paralysis occur; the first muscles affected are usually the toe extensors and the peronei. In only the most severe cases will paralysis of flexor muscles of the feet or of the extensor muscles of hands occur.

Liver damage from chronic arsenical poisoning is still debated, and as yet the question is unanswered. In cases of chronic and acute arsenical poisoning, toxic effects to the myocardium have been reported based on EKG changes. These findings, however, are now largely discounted and the EKG changes are ascribed to electrolyte disturbances concomitant with arsenicalism. Inhalation of arsenic trioxide and other inorganic arsenical dusts does not give rise to radiological evidence of pneumoconiosis. Arsenic does have a depressant effect upon the bone marrow, with disturbances of both erythropoiesis and myelopoiesis.

Bibliography

Dinman, B.D. 1960. Arsenic; chronic human intoxication. *J. Occup. Med.* 2:137.

Elkins, H.B. 1959. *The Chemistry of Industrial Toxicology*, 2nd ed. John Wiley and Sons, New York.

Holmquist, L. 1951. Occupational Arsenical dermatitis; a study among employees at a copperore smelting works

include investigations of skin reactions to contact with arsenic compounds. *Acta. Derm. Venereol.* (Supp. 26) 31:1.

Pinto, S.S., and C.M. McGill. 1953. Arsenic trioxide exposure in industry. *Ind. Med. Surg.* 22:281.

Pinto, S.S., and K.W. Nelson, 1976. Arsenic toxicology and industrial exposure. *Annu. Rev. Pharmacol. Toxicol.* 16:95.

Vallee, B.L., D.D. Ulmer, and W.E.C. Wacker, 1960. Arsenic toxicology and biochemistry. *AMA Arch. Indust. Health* 21:132.

III. SPUTUM CYTOLOGY

Sputum can be collected by aerosol inhalation during the medical exam or by spontaneous early morning cough at home. Sputum is induced by transoral inhalation of an aerosolized solution of eight percent (8 percent) sodium

chloride in water. After inhaling as few as three to five breaths the subject usually yields an adequate sputum. All sputum should be collected directly into sixty percent (60 percent) alcohol.

Scientific evidence suggests that chest x-rays and sputum cytology should be used together as screening tests for lung tests for lung cancer in high risk populations such as workers exposed to inorganic arsenic. The tests are to be performed every six months on workers who are 45 years of age or older or have worked in the regulated area for 10 or more years. Since the tests seem to be complementary, it may be advantageous to alternate the tests procedures. For instance, chest x-rays could be obtained in June and December and sputum cytologies could be obtained in March and September. Facilities for providing necessary diagnostic investigation should be readily available as well as chest physicians, surgeons, radiologists, pathologists and immunotherapists to provide any necessary treatment services.

Total Units Printed:	3,000
Total Printing Cost:	\$540.30
Cost Per Unit:	\$0.180